

Pinpointing air conditioning under-performance

Many A/C plants do not perform to specification, wasting energy and costing thousands of pounds in inflated fuel bills.

Mike Creamer looks at the scale of the problem and a viable solution

Running air conditioning plant when it is either short of refrigerant or over-charged, is a bit like running a car without enough water in the radiator. Sooner or later, something bad (and expensive) is going to happen.

With an under-charged system, the expensive bit begins to happen right away, as the plant runs significantly less efficiently than a correctly charged system. The plant actually draws less electrical current, but runs for extended periods when it fails to achieve the same cooling or heating output. The same syndrome arises on many types of plant that are excessively overcharged with refrigerant.

With electricity prices rising by a two-thirds over the past two years, and predicted to increase further, building owners and operators need to wise up to the haemorrhaging of money represented by their underperforming air conditioning systems.

In the longer term, running air conditioning with insufficient refrigerant charge forces plant to work longer and harder to achieve the required capacity, causing premature wear, component breakdown and reduced working life.

The big picture here is sobering. Many – dare I say most - buildings operate well below optimum efficiency much of the time. An important part of this relates to the building services in general, and air conditioning in particular. Poor maintenance and undiagnosed refrigerant loss (or excess charge) are the most common causes of underperformance and energy wastage. Similar problems arise where plant is not correctly set up for efficient and optimum performance.

Studies carried out on the Continent suggest that up to 90 per cent of air conditioned buildings operate below design specification. On this basis, there will be some nasty surprises when the results start coming out from the new mandatory inspections of building efficiency required under the Energy Performance of Buildings Directive (EPBD).

No one wants to occupy an inefficient building. It's expensive – in terms of both energy and reputation. For large companies and public bodies with corporate sensitivities, the requirement to display an energy rating on their buildings will be an all-too-public statement of their actual, rather than their declared environmental credentials.

The EPBD highlights the significant contribution of air conditioning to the overall energy performance of buildings. Under Article Nine, EU members are required to implement mandatory inspections for air conditioning, to evaluate and improve building energy performance.

In this country, this requirement is being implemented by the Energy Performance of Buildings (Certificates and Inspections) (England and Wales) Regulations 2007. This requires all air conditioning plant over 250kW to be inspected by January 2009; and all systems between 12 and 250kW to be inspected by January 2011.

The inspections are intended to evaluate the efficiency and appropriateness of plant sizing in relation to the cooling/heating requirements of the building. Inspectors are also required to advise building operators on possible improvements to systems to enhance efficiency – including, where relevant, possible replacement of plant.

Conducting these inspections in the real world, however, is going to pose genuine difficulties for inspectors. Ideally, buildings would be fitted with energy sub-meters to the main air conditioning components. Operators would have a building log book, with descriptions of the air conditioning system, locations and specifications, and details of controls. This would give the inspector an objective starting point for the performance assessments.

However, as CIBSE concedes in Technical Memorandum 44, the majority of buildings will not have this data available. Therefore, air conditioning inspectors will have to use a variety of less direct techniques on which to try and make an evaluation.

According to CIBSE: “Obtaining a good estimate of air conditioning efficiency can be a very complex process, involving a considerable involvement in time, equipment and expertise.” Therefore, it suggests, “inspection will primarily be based on visual observations and non-invasive measurements.”

This approach has some fundamental drawbacks. For a start, it uses unquantifiable techniques that are open to challenge. If the outcome of an evaluation is negative, with energy costs escalating it could affect the future rentable value of the property. It is a potential legal minefield for inspectors.

The second weakness of the proposed approach relates to the difficulty of ensuring consistency between inspections. If performance assessments are based on a variety of subjective techniques, differing between buildings and inspectors, then it casts doubt on the cross-comparability of results.

It is a straightforward matter to determine the efficiency of a domestic fridge or kettle. However, accurately assessing the efficiency of a complicated air conditioning system serving a large building is an entirely different proposition.

That, at least, has been the accepted wisdom until recently. Now, a new technique has been developed that makes it possible to quickly and precisely determine the actual efficiency of operating air conditioning plant – without intruding into the system.

It uses a new piece of technology called ClimaCheck, developed by Swedish thermodynamics pioneer, Klas Berglof. With this, it is possible to gain a quantitative measure of the Coefficient of Performance (COP) of an operating air conditioning system – which, using alternative approaches, would take weeks and hundreds man-hours to achieve.

The instrument is being used by end users and engineers in Scandinavia to provide reliable, consistent and comparable assessments of the performance of air conditioning and refrigeration plant.

Here, leading high street supermarkets are now employing the technology to obtain quantitative assessments of the efficiency and performance of cooling systems – never before possible in relation to operating plant in real world as opposed to test-bed conditions.

A stark fact emerges from the accumulating experience with ClimaCheck. Klas Berglof reports: “It has become clear that most air conditioning plant operates well below optimum efficiency. A significant proportion of installations are dramatically underperforming against design – whether due to poor maintenance, refrigerant undercharge, incorrect control, or mismanagement.”

How does ClimaCheck work? The instrument dynamically measures, calculates and records every key parameter of a running plant – and uses sophisticated algorithms to determine its operating characteristics.

It can be used with any type and configuration of plant, running on any type of refrigerant. Even the otherwise very difficult to measure COP (Coefficient of Performance), Cooling / Heating Capacity and Compressor Isentropic Efficiency can be readily determined – without the need to measure air / water flow rates or temperatures! Defects and faults in system components can also be pin-pointed, enabling users to anticipate future breakdown.

The system can be hooked up to a plant in 30 minutes, with results available immediately. A version for DIN rail-mounting can be permanently or temporarily installed, with results logged locally or remotely over the internet. There is an option of automatic alarm dial-out, in the event of a major problem, including detection of refrigerant loss!

As the initial wave of inspections begins, those equipped with this latest technology will be much better positioned to deliver what the EPBD requires. If challenged, they will be able to provide objective proof of determined air conditioning efficiency, and defend possibly controversial assessments.

Mike Creamer is managing director of Business Edge, UK sole distributor for ClimaCheck. The company can be contacted on 02392 230007.

How ClimaCheck works

- The technology was developed by Swedish inventor and refrigeration pioneer Klas Berglof. He has worked for 20 years on the sophisticated mathematical algorithms on which the system is based.
- It is a so-called “non-invasive technology”, as it does not require large-scale intrusion into the refrigeration circuit.
- Instead, it uses simple measurements from working plant to calculate key parameters on system performance.
- With a few basic measurements, it can calculate: overall efficiency for both cooling and heating, system capacity, compressor efficiency – as a measure of wear, superheat in the evaporator, sub-cooling in the condenser.
- Armed with this information, A/C engineers can then optimise plant performance – resulting in huge savings in power and carbon emissions.

What air conditioning inspections are required?

Existing air conditioning systems greater than 250kW will need to have their first inspection by 4 January 2009.

Existing systems greater than 12kW will need to have their first inspection by 4 January 2011.

For further information about EPCs, Display Certificates, air conditioning inspections and Home Information Packs, visit:

Communities and Local Government –
www.communities.gov.uk/epbd

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